Air Force Research Laboratory|AFRL

Science and Technology for Tomorrow's Air and Space Force

Materials and Manufacturing Directorate

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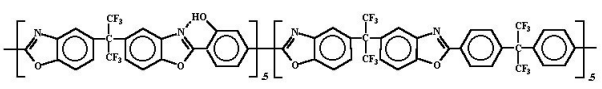
Polymers

A polymer is a large organic compound, natural or synthetic, with a structure that can be represented by a repeated small unit – the mer. The length of the polymer chain has very significant effects on the performance properties of plastics and profound effects on processibility.

AFOSR's goal in this research area is to gain a better understanding of the influence of chemical structures and processing conditions on the properties and behaviors of polymeric and organic materials. This understanding will lead to development of advanced polymeric materials for Air Force applications. The approach is to study the chemistry and physics of these materials through synthesis, processing, and characterization. This area addresses both functional properties and properties pertinent to structural applications. Materials with these properties will provide capabilities for future Air Force systems to achieving global awareness, global mobility, and space operations as envisioned in New World Vistas.

Current interests include photonic polymers, polymers with interesting electronic properties, liquid crystals, bio-inspired materials and nanostructures.

In the area of photonic polymers, research emphases are placed on electro-optic and photorefractive polymers. Organic molecules with large multiphoton absorption cross sections are also of interest. It is desirable to increase the electro-optical coefficients of organic and polymeric materials with appropriate levels of thermal and temporal stability. Space operation issues of these polymers are also of interest. Control of speed and wavelength sensitivity in organic photorefractive polymers is currently supported. Examples of electronic properties of interest include conductivity, electrochromaticism, electroluminescence, electro-pumped lasing and superconductivity. In the area of structural properties, polymers with high thermomechanical



properties are desirable. End uses of these structural polymers include aircraft and rocket components, canopies, coatings, and space structures. Issues relating to impact toughness and lifetime durability are of special interest.

One high performance polymer developed at the Materials and Manufacturing Directorate is being used to make tethers that keep tires and wheel assemblies attached to race cars when they crash. Polybenzobisoxazole (PBO), known commercially as Zylon™, helps protect drivers and spectators from injury and death when wheel components fly out of control at major racing events such as the "Indianapolis 500." Originally developed for high temperature aerospace applications such as flame retardant flight suits and aircraft seat covers, PBO is part of a family of polymers known for their flame and abrasion resistance and outstanding tensile mechanical properties. PBO is now being used in a wide variety of commercial products including tires, belts, hose, plastics, concrete, cords, gaskets, abrasive materials, heat and flame resistant clothing, ballistic flak vests, cut and abrasion resistant safety gloves and protective clothing for firefighters.

For more information on the Materials and Manufacturing Directorate visit www.afrl.af.mil, call (937) 255-6469 or send an email with your question to techinfo@wpafb.af.mil